



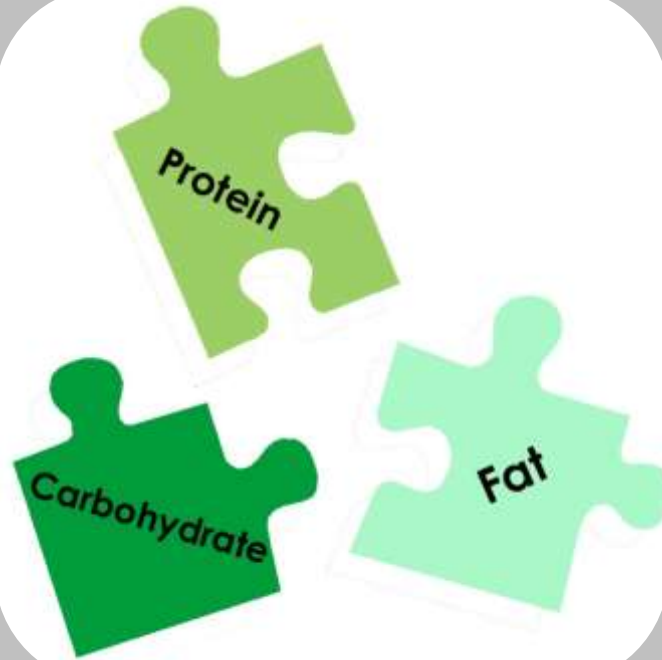
Micronutrient Malnutrition and Effective Interventions: The Global Picture



Flour Fortification Initiative

A Public-Private-Civic Investment in Each Nation

Nutrients



www.blog.com

MACRO

Body needs in large amounts

MICRO

Body needs in small amounts

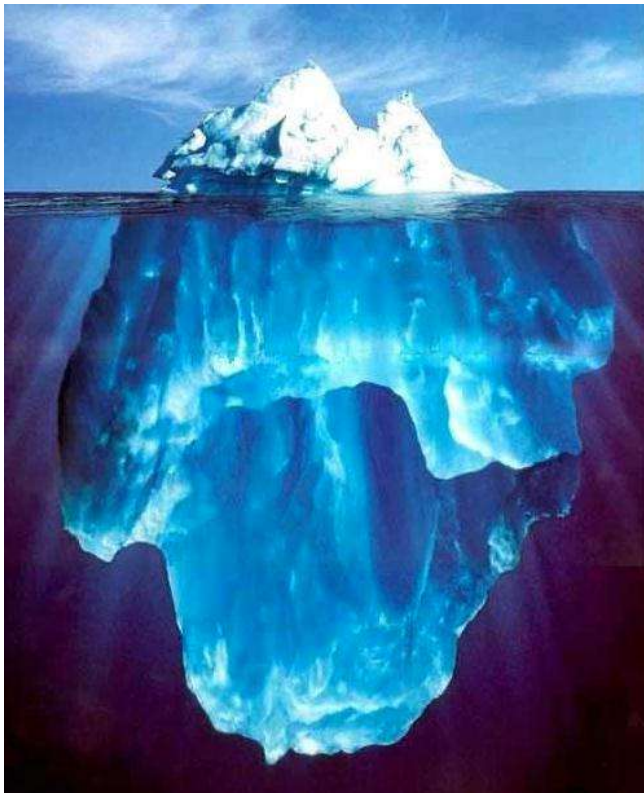


www.clivir.com



Micronutrient Malnutrition

Also known as Hidden Hunger

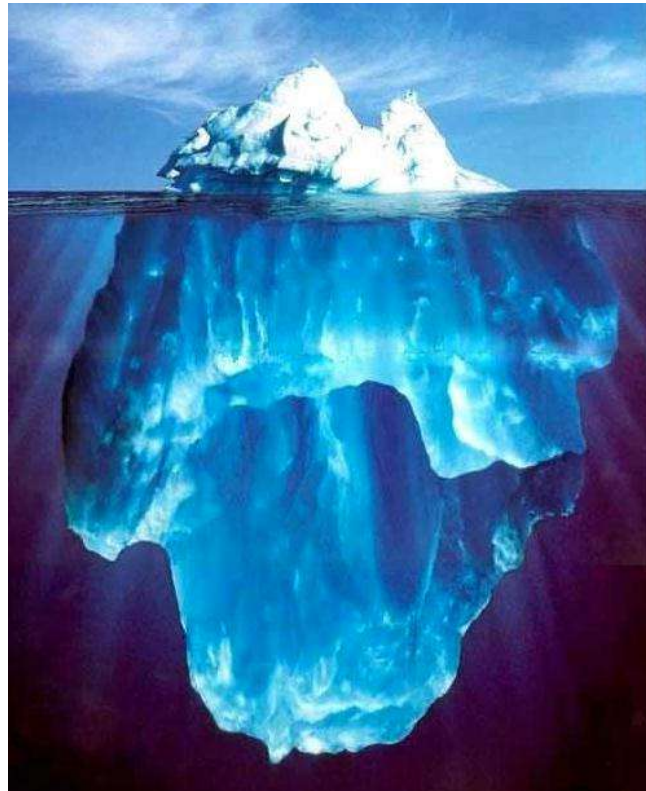


www.blogspot.com

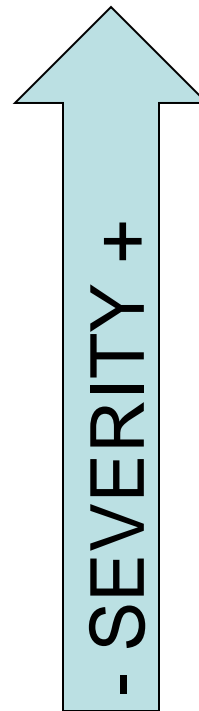


Micronutrient Malnutrition

Also known as Hidden Hunger



www.blogspot.com



Corneal ulceration



www.motherandchildnutrition.org

Night blindness

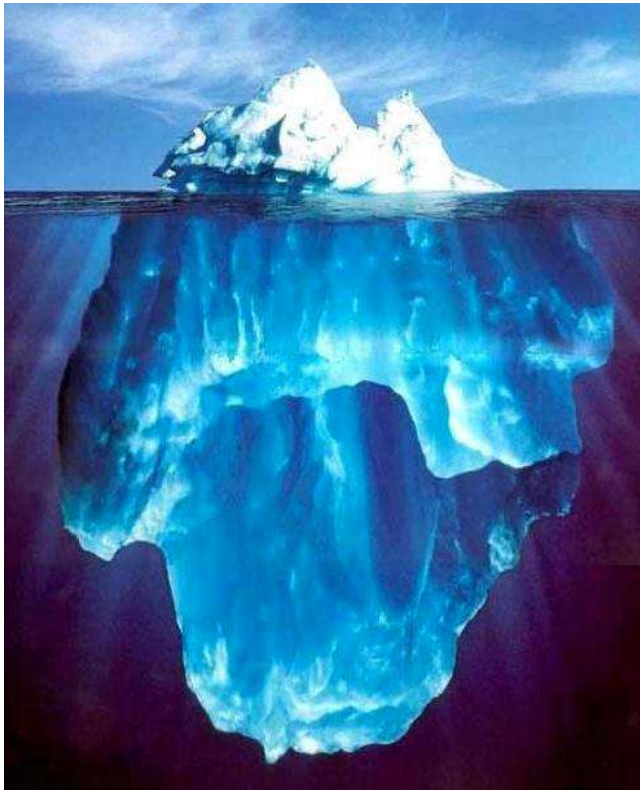


www.steadyhealth.com

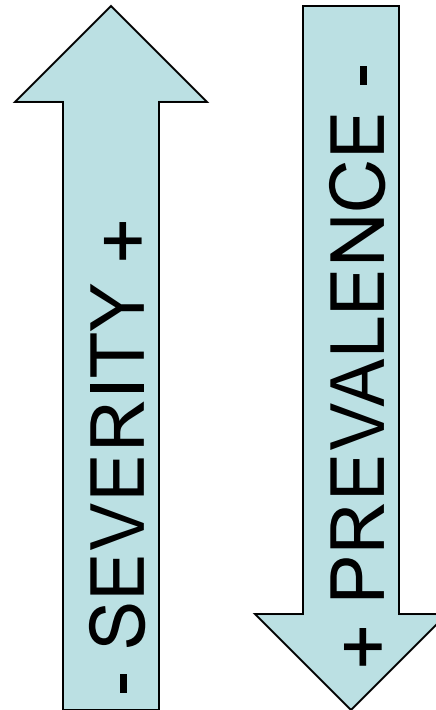


Micronutrient Malnutrition

Also known as Hidden Hunger



www.blogspot.com



Corneal ulceration or xerosis (1.7%)



www.motherandchildnutrition.org

Night blindness (38.4%)



www.steadyhealth.com



Micronutrient Malnutrition

Nutrients	Global Burden of Disease ¹	Lancet ²	Food fortification ^{3*}	VMNIS ⁴
Folate		X	X	
Iodine		X	X	X
Iron [anemia]	X	X	X	X
Vitamin A	X	X	X	X
Vitamin B12		X	X	
Zinc		X	X	
*Others	<i>Vitamins B1, B2, B3, B6, C, D, Calcium, Selenium, Fluoride</i>			

¹WHO 2004. Global Burden of Disease.

²Lancet 2008. Maternal and Child Undernutrition.

³WHO/FAO 2006. Guidelines on Food Fortification with Micronutrients.

⁴WHO. Vitamin and Mineral Nutrition Information System.



Micronutrient Malnutrition: Folate

Physiological functions:

- “Essential for DNA biosynthesis
- Donates methyl (*methylation*) to lipids, hormones, DNA and proteins”

Consequences of deficiency:

- Anemia
- Neural tube defects (NTDs)

Consequences of insufficiency:

- Neural tube defects



www.media.rbi.com.au

Folate Sufficiency

“Has a protective role against first occurrence and recurrence of NTDs”

WHO 2004. Vitamin and mineral requirements in human nutrition.

IOM 1998. Dietary Reference Intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline.

Folic Acid Working Group 2010. Fortification of flour with folic acid.

Daly 1995. Folate levels and neural tube defects.

McNulty 2008. Intake and status of folate and related B-vitamins.



Micronutrient Malnutrition: Folate

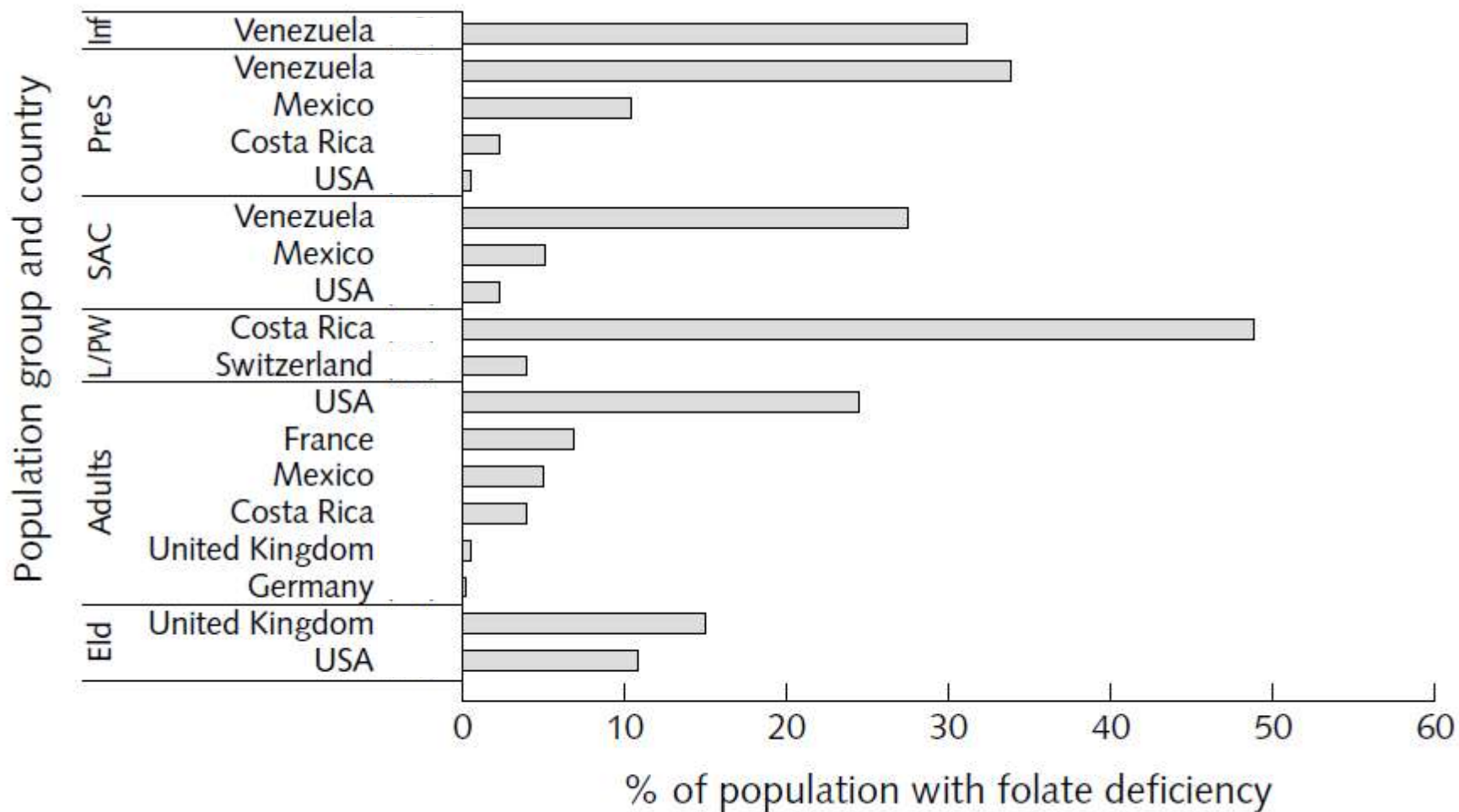


FIG. 3. Prevalence of folate deficiency in countries with nationally representative data.



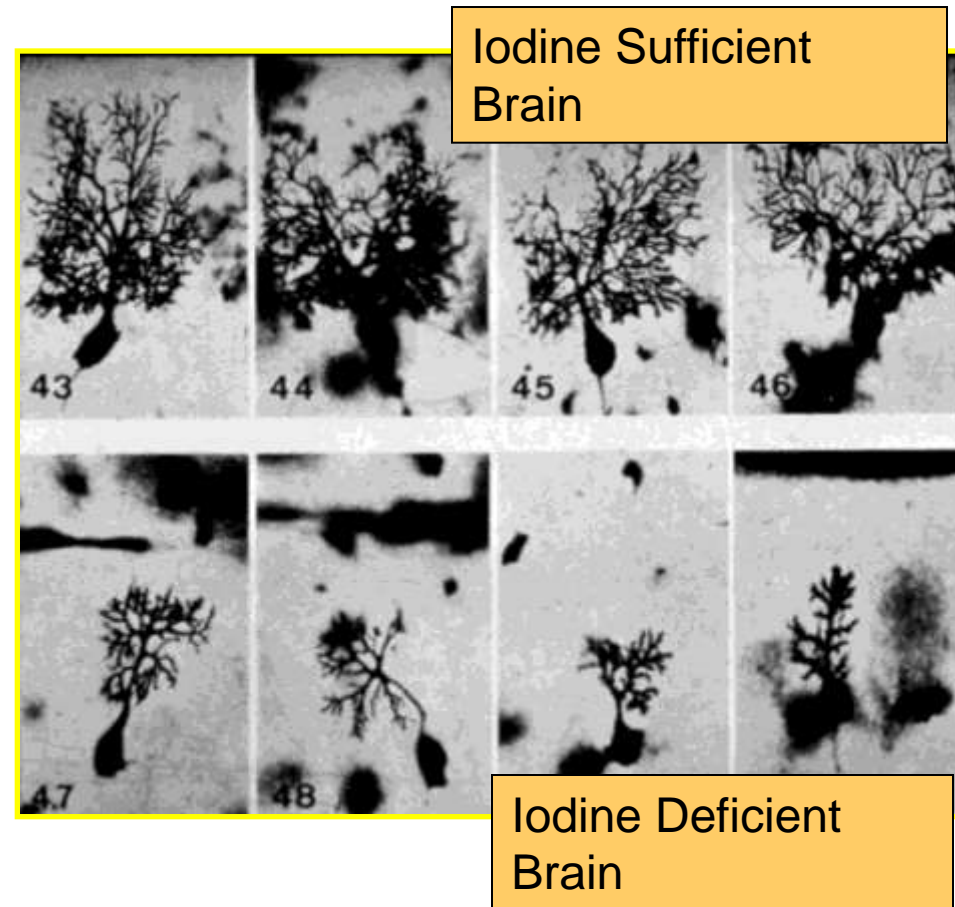
Micronutrient Malnutrition: Iodine

Thyroid Hormones

- “Play major role in growth & development of brain and central nervous system
- Control several metabolic processes”

Iodine Deficiency

The greatest cause of preventable brain damage in childhood



Images courtesy of Glen Maberly



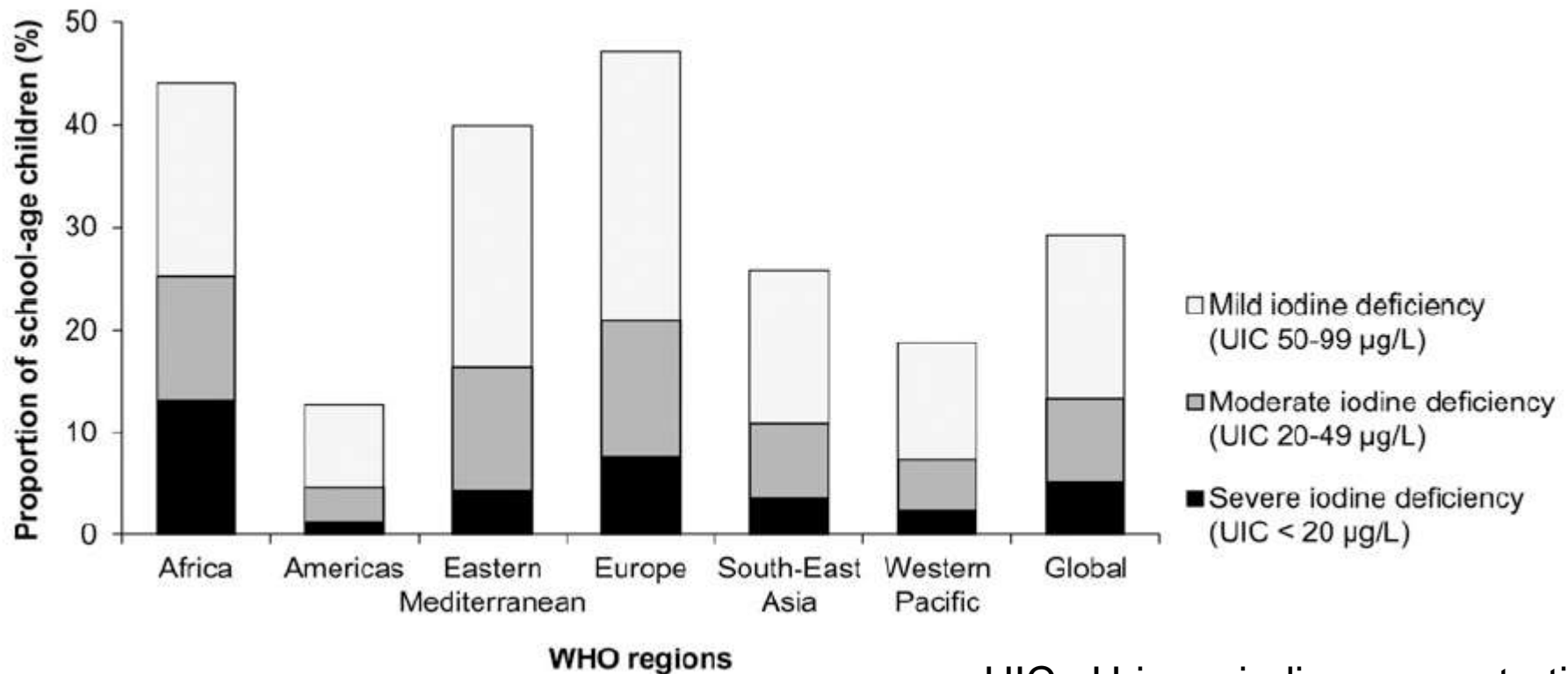
WHO 2004. Vitamin and mineral requirements in human nutrition.

WHO 2004. Iodine status worldwide.

Stanbury. The damaged brain of iodine deficiency.

Micronutrient Malnutrition: Iodine

Proportion of School-age Children Estimated to be At Risk for Mild, Moderate and Severe Iodine Deficiency, by WHO Region, 2011



UIC: Urinary iodine concentration



Micronutrient Malnutrition: Iron



www.thegreenleaves.wordpress.com

Physiological functions:

- “Carries oxygen from the lung to tissues
- Transports electrons within cells
- Part of enzyme systems in various tissues”

Consequences of deficiency:

- Decreased hemoglobin production
- Impaired delivery of oxygen to tissues (anemia)
- Reduced cognitive development
- Reduced work capacity

Iron Deficiency

The most common nutritional deficiency in the world



Micronutrient Malnutrition: Iron

Anemia used as a proxy indicator for iron status

Table 3.3 Anaemia prevalence and number of individuals affected in preschool-age children, pregnant women, and non-pregnant women in each WHO region

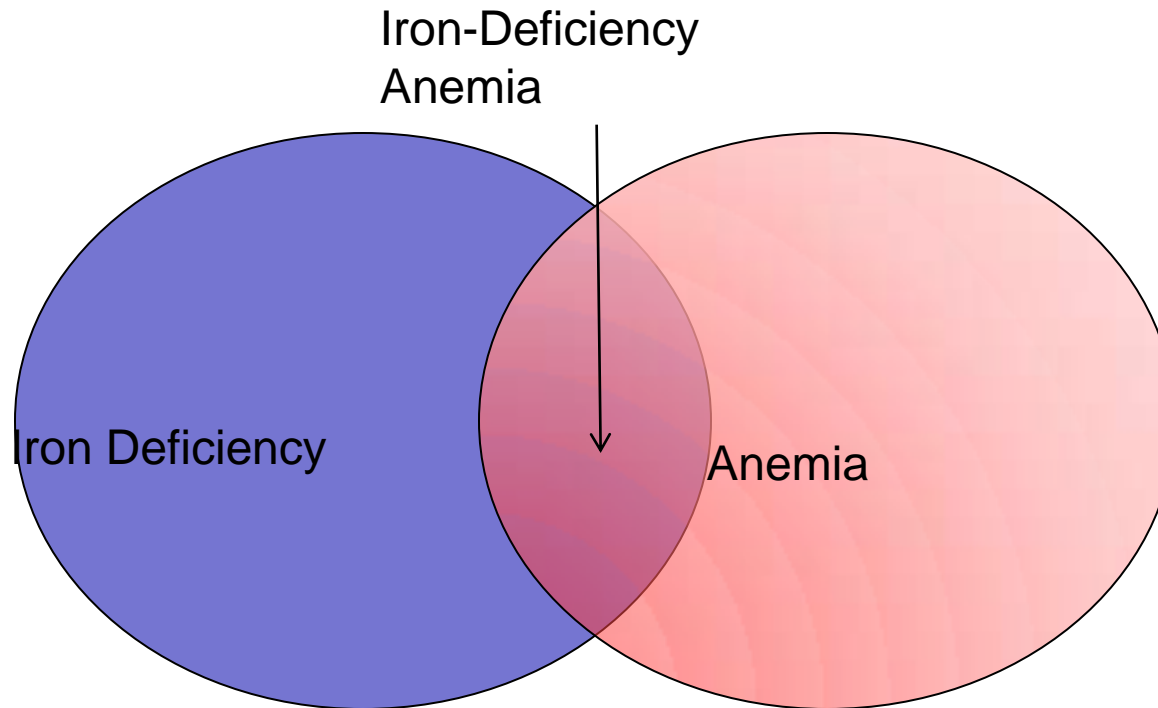
WHO region	Preschool-age children ^a		Pregnant women		Non-pregnant women	
	Prevalence (%)	# affected (millions)	Prevalence (%)	# affected (millions)	Prevalence (%)	# affected (millions)
Africa	67.6	83.5	57.1	17.2	47.5	69.9
Americas	29.3	23.1	24.1	3.9	17.8	39.0
South-East Asia	65.5	115.3	48.2	18.1	45.7	182.0
Europe	21.7	11.1	25.1	2.6	19.0	40.8
Eastern Mediterranean	46.7	0.8	44.2	7.1	32.4	39.8
Western Pacific	23.1	27.4	30.7	7.6	21.5	97.0
Global	47.4	293.1	41.8	56.4	30.2	468.4

^a Population subgroups: Preschool-age children (0.00–4.99 yrs); Pregnant women (no age range defined); Non-pregnant women (15.00–49.99 yrs).

^b 95% Confidence Intervals.



Micronutrient Malnutrition: Iron



Causes:

- Deficient iron intake
- Excessive iron loss

Causes:

- Deficiency of iron, vitamin B12, folate, vitamin A
- Hemoglobinopathies
- Infections



Micronutrient Malnutrition: Vitamin A



www.cascadilla.com

Physiological functions:

- “Needed for normal functioning of the visual system
- Required for growth and development
- Used in maintenance of epithelial cellular integrity, immune function, and reproduction”



Micronutrient Malnutrition: Vitamin A

Consequences of deficiency:

- Xerophthalmia
- Anemia
- Worsen infection
- Increase mortality

Table 1 **Classification of xerophthalmia**

XN	Night blindness
X1A	Conjunctival xerosis
X1B	Bitot's spot
X2	Corneal xerosis
X3A	Corneal ulceration/keratomalacia (< 1/3 corneal surface)
X3B	Corneal ulceration/keratomalacia (≥ 1/3 corneal surface)
XS	Corneal scar
XF	Xerophthalmic fundus

Vitamin A Deficiency

One of the most important causes of preventable childhood blindness

Major contributor to morbidity and mortality from infections



Micronutrient Malnutrition: Vitamin A

Table 11 *Prevalence of serum retinol <0.70 µmol/l and number of individuals affected among preschool-age children and pregnant women in populations of countries at risk of vitamin A deficiency 1995–2005, globally and by WHO region*

WHO region	Preschool-age children ^a		Pregnant women	
	Prevalence ^b (%)	# affected (millions)	Prevalence (%)	# affected (millions)
Africa	44.4	56.4	13.5	4.18
Americas	15.6	8.68	2.0	0.23
South-East Asia	49.9	91.5	17.3	6.69
Europe	19.7	5.81	11.6	0.72
Eastern Mediterranean	20.4	13.2	16.1	2.42
Western Pacific	12.9	14.3	21.5	4.90
Global	33.3	190	15.3	19.1

^a Population subgroups: Preschool-age children (<5 years); Pregnant women (no age range defined).

^b Numerator and denominator excludes countries with a 2005 GDP \geq US\$ 15 000.

^c 95% Confidence Intervals.



Micronutrient Malnutrition: Vitamin B12

Cobalamin

Physiological function:

“As a cofactor for the enzymes methionine synthase and L-methylmalonyl-CoA mutase”

Consequences of deficiency:

- Anemia
- Neurological complications



Vitamin B12
Essential for normal blood formation
and neurological function

WHO 2004. Vitamin and mineral requirements in human nutrition.

IOM 1998. Dietary Reference Intakes for thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, pantothenic acid, biotin, and choline.

Smith 2009. Vitamin B-12 and cognition in the elderly.



Micronutrient Malnutrition: Vitamin B12

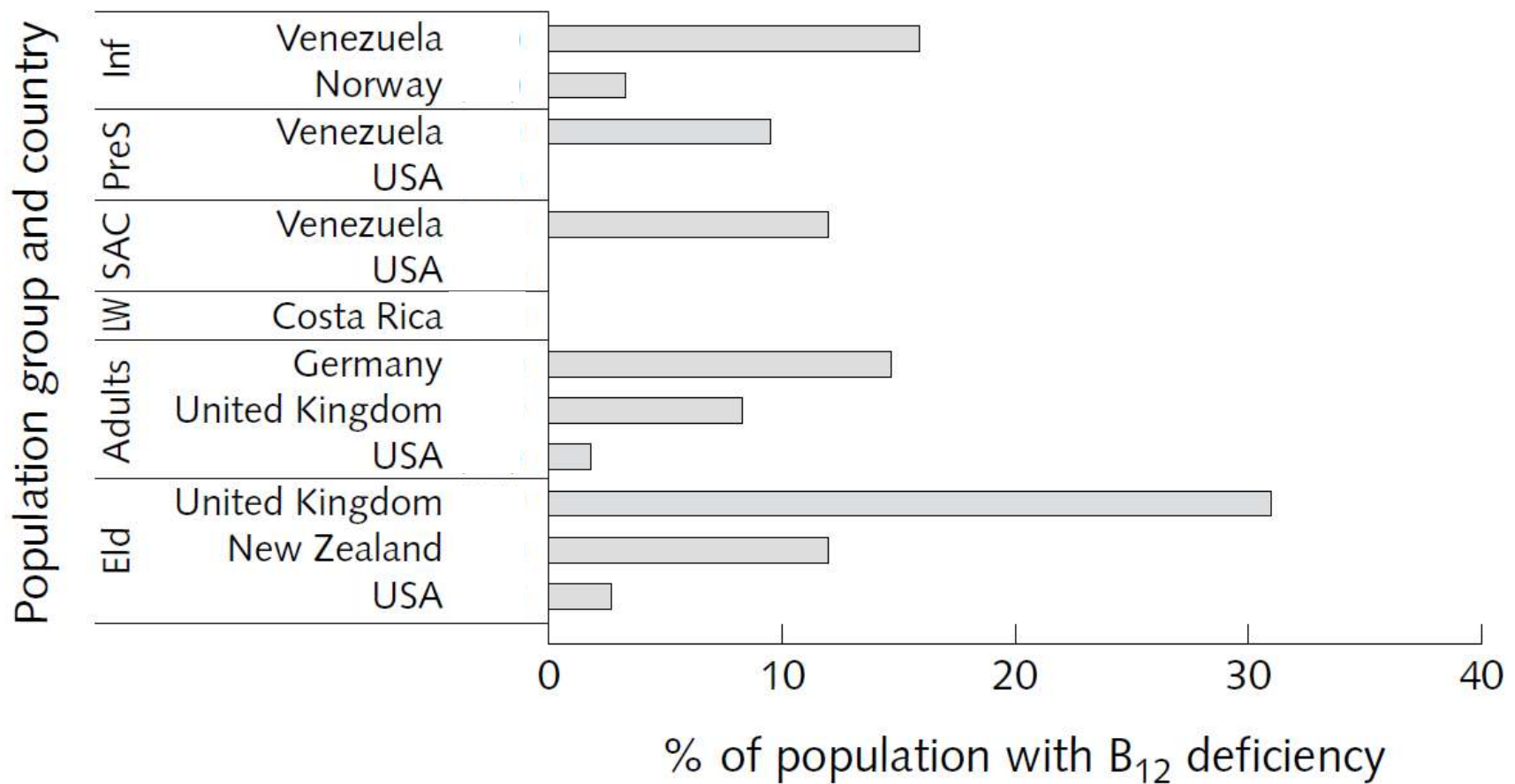


FIG. 4. Prevalence of vitamin B₁₂ deficiency in countries with nationally representative data.



Micronutrient Malnutrition: Zinc

Physiological function:

“Essential component of a large number (>300) of enzymes participating in the synthesis and degradation of carbohydrates, lipids, proteins, and nucleic acids as well as in the metabolism of other micronutrients”



www.wordpress.com



Micronutrient Malnutrition: Zinc

Consequences of deficiency:

Severe Zinc Deficiency	Mild Zinc Deficiency
Growth retardation	Growth retardation
Delayed sexual & bone maturation	
Skin lesions	
Diarrhea	
Alopecia	
Impaired appetite	
Impaired immunity	Impaired immunity
Behavioral changes	

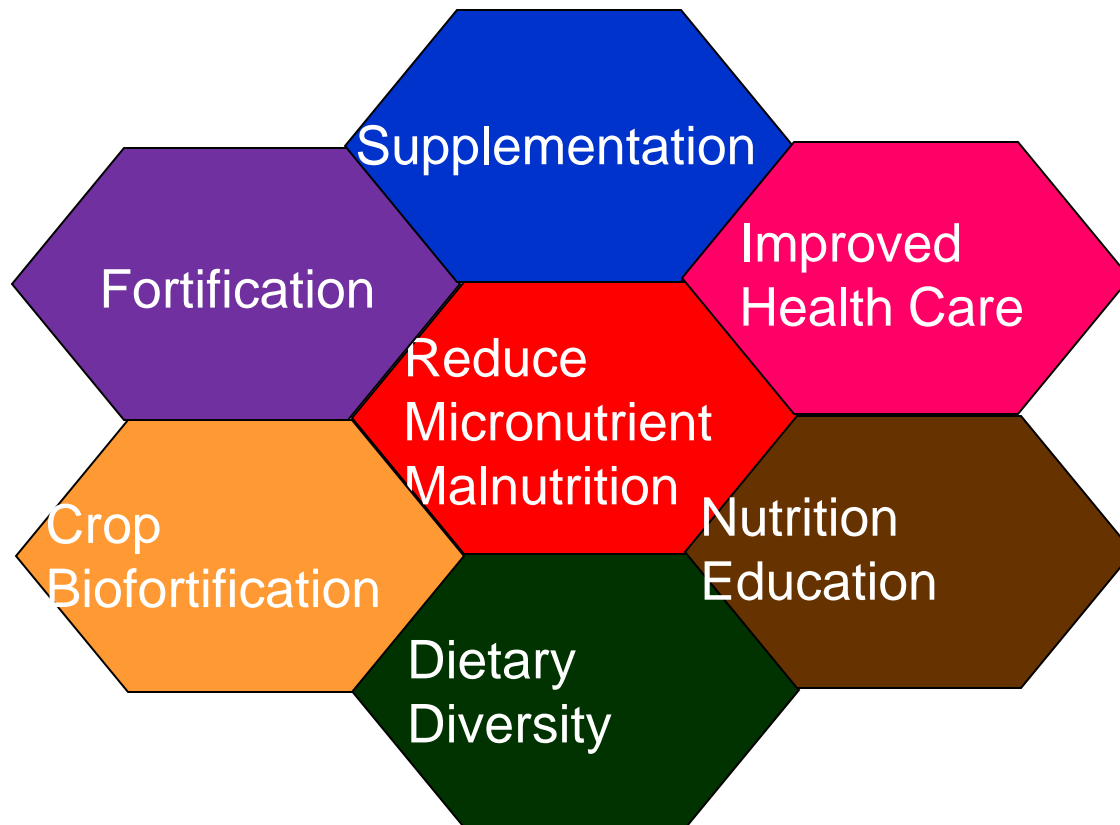
Zinc Deficiency

Increases morbidity and mortality and delays growth



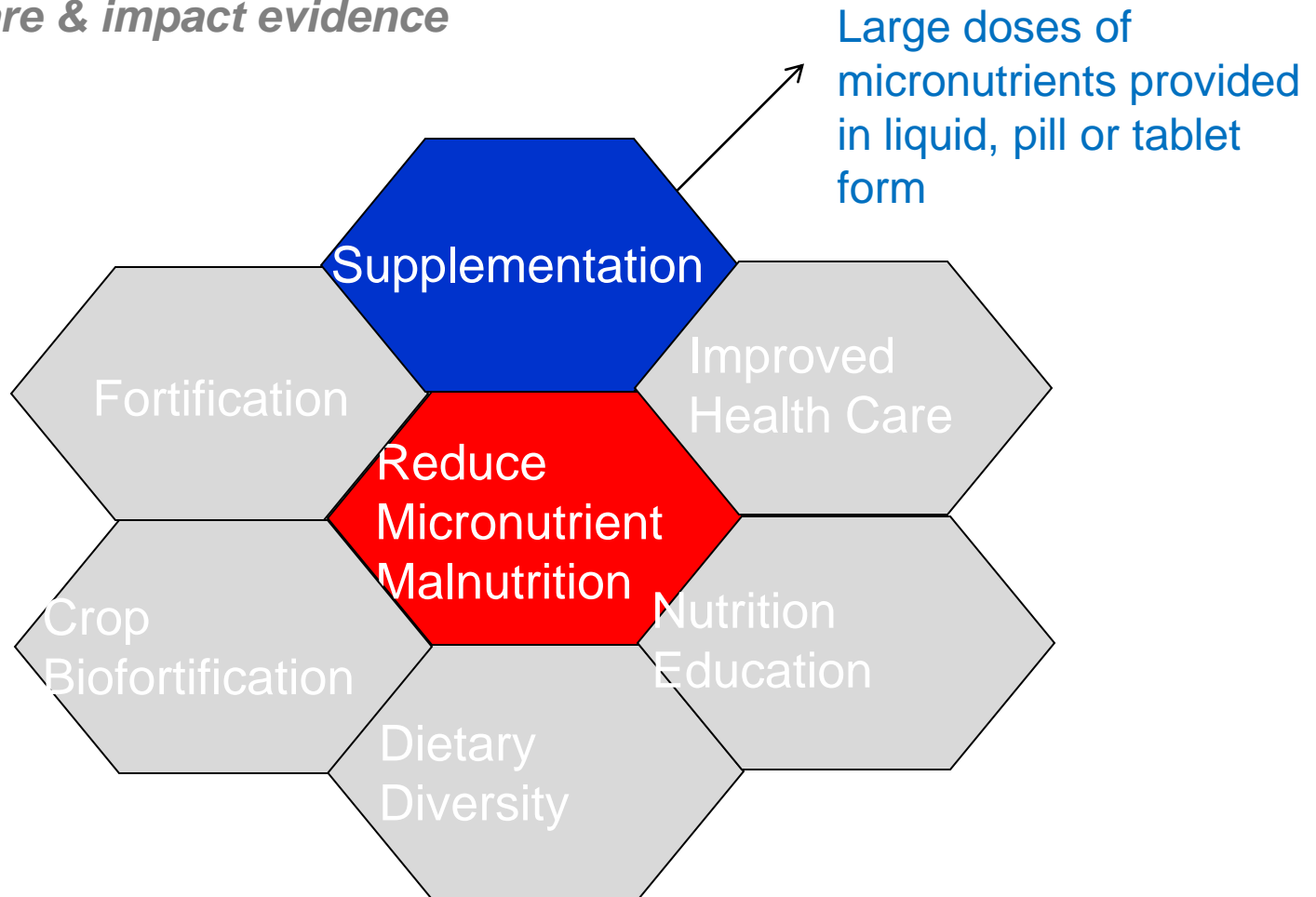
Public Health Interventions

Multiple and complementary



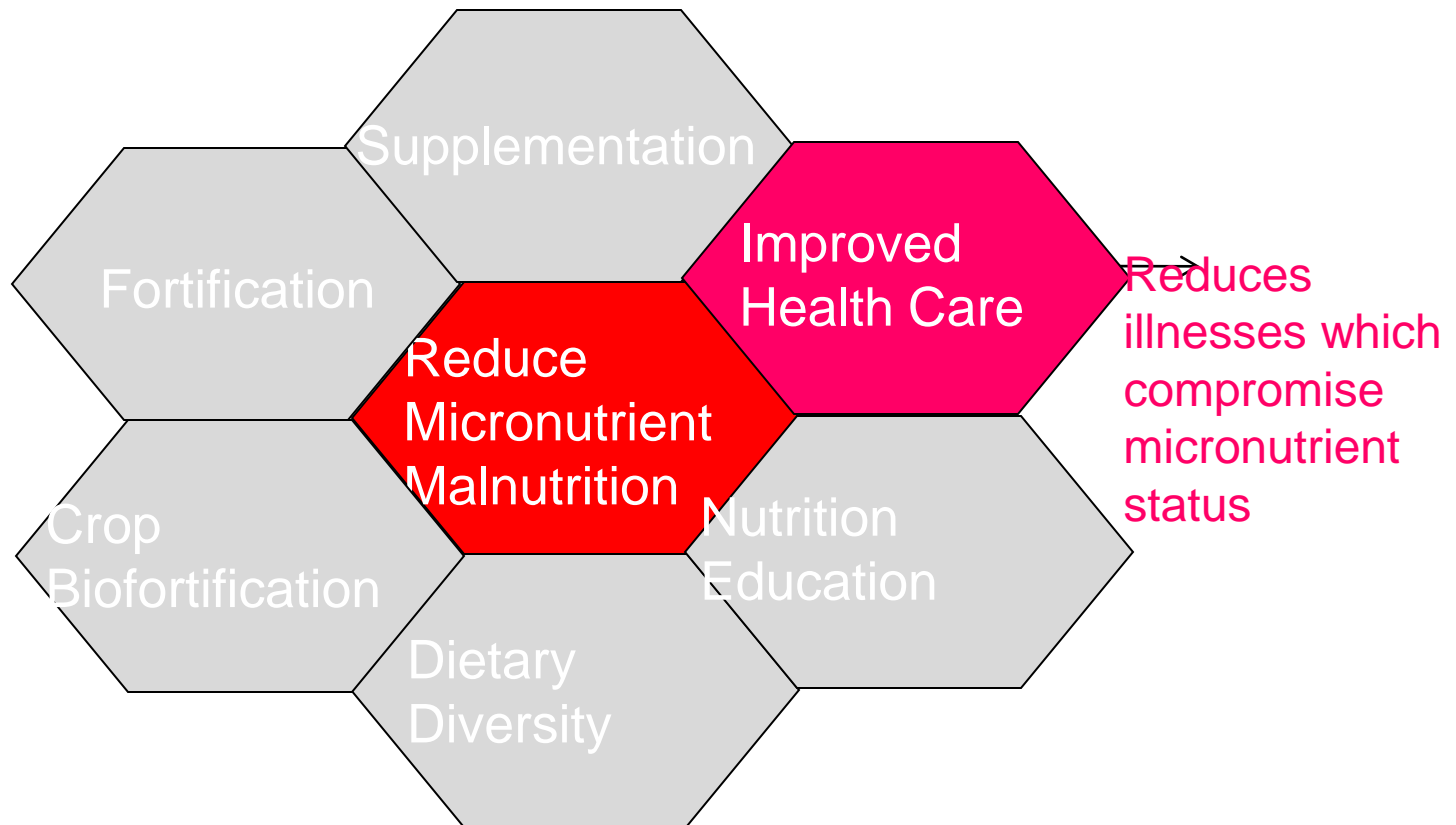
Public Health Interventions

What they are & impact evidence



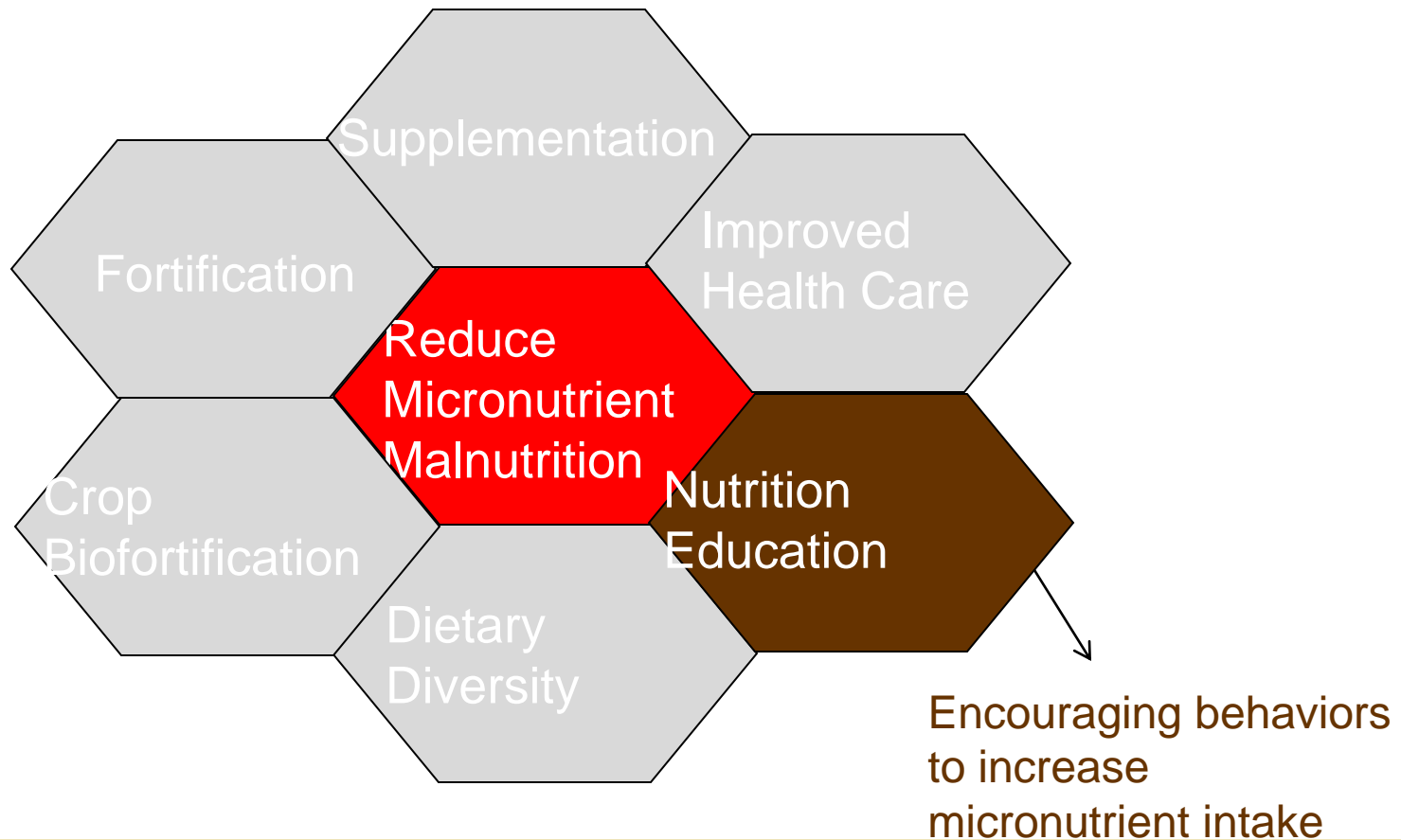
Public Health Interventions

What they are & impact evidence



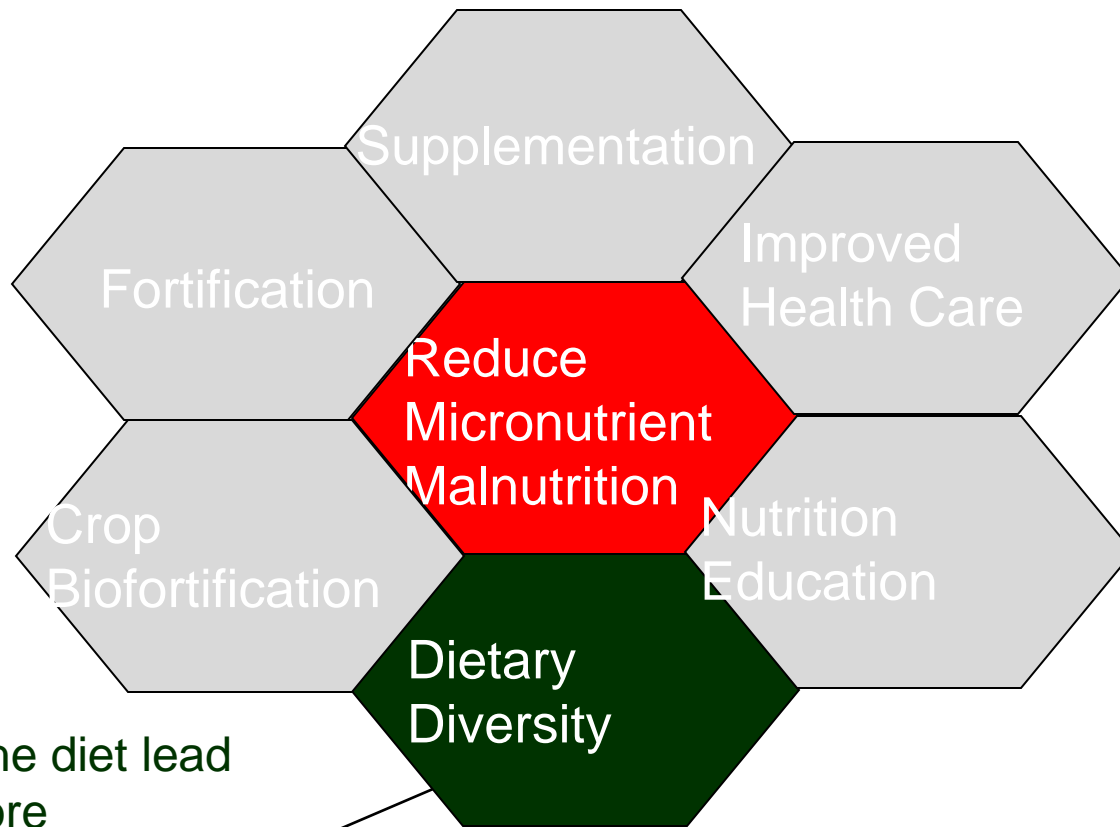
Public Health Interventions

What they are & impact evidence



Public Health Interventions

What they are & impact evidence

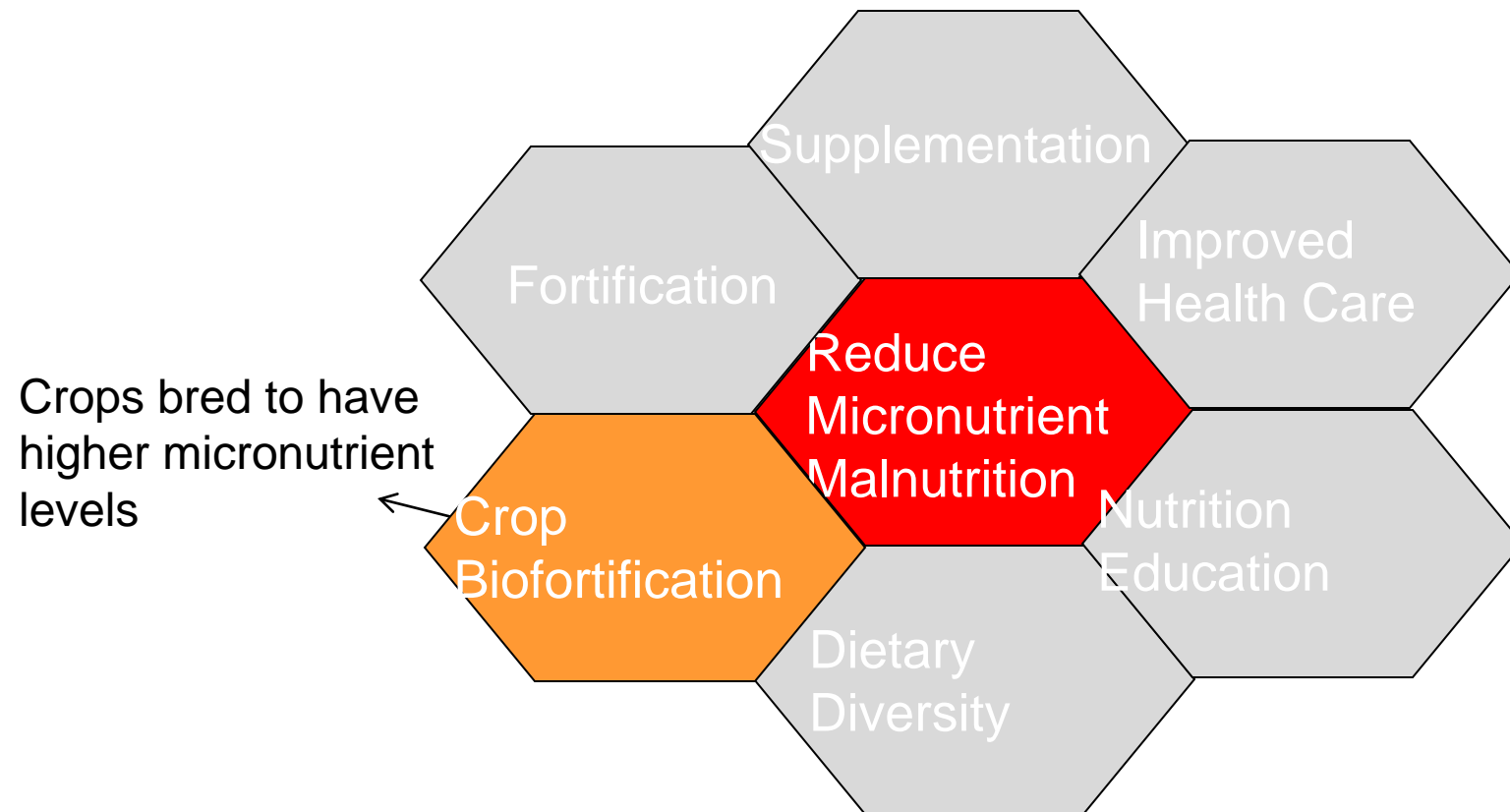


More foods in the diet lead to intakes of more micronutrients



Public Health Interventions

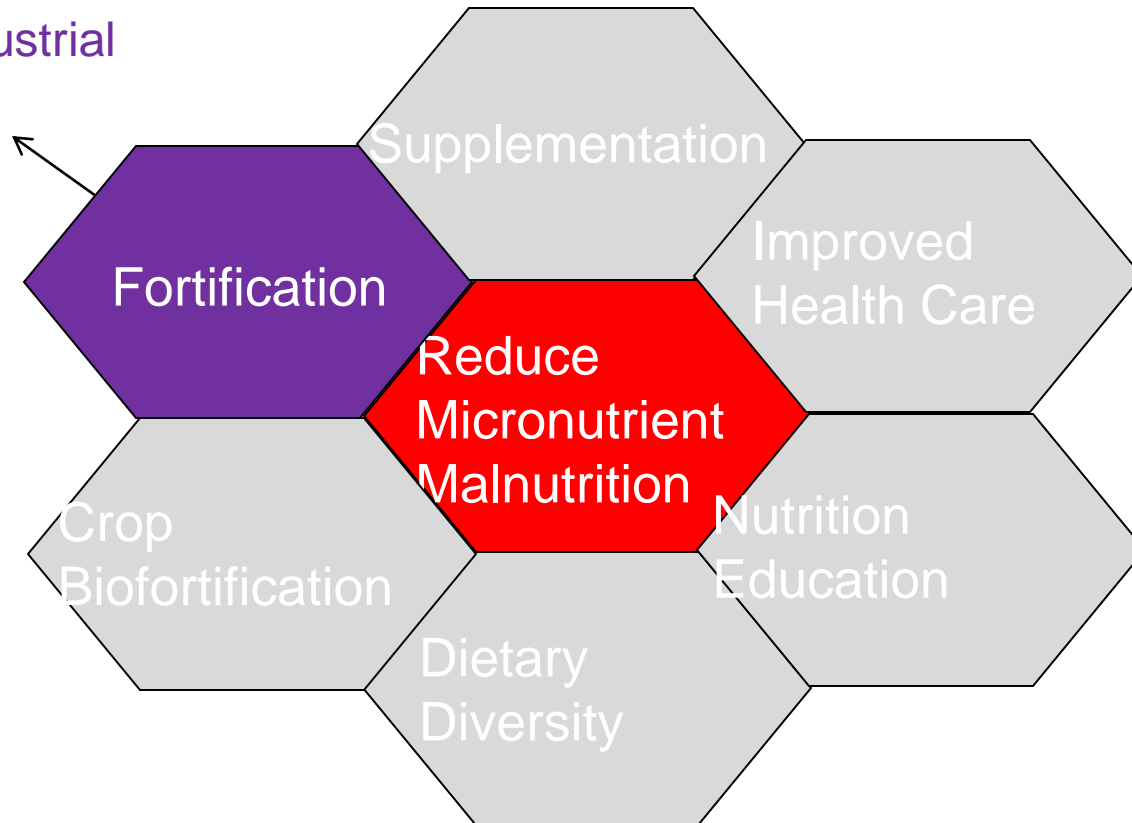
What they are & impact evidence



Public Health Interventions

What they are & impact evidence

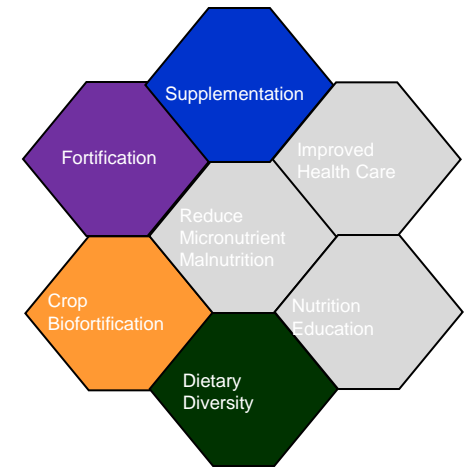
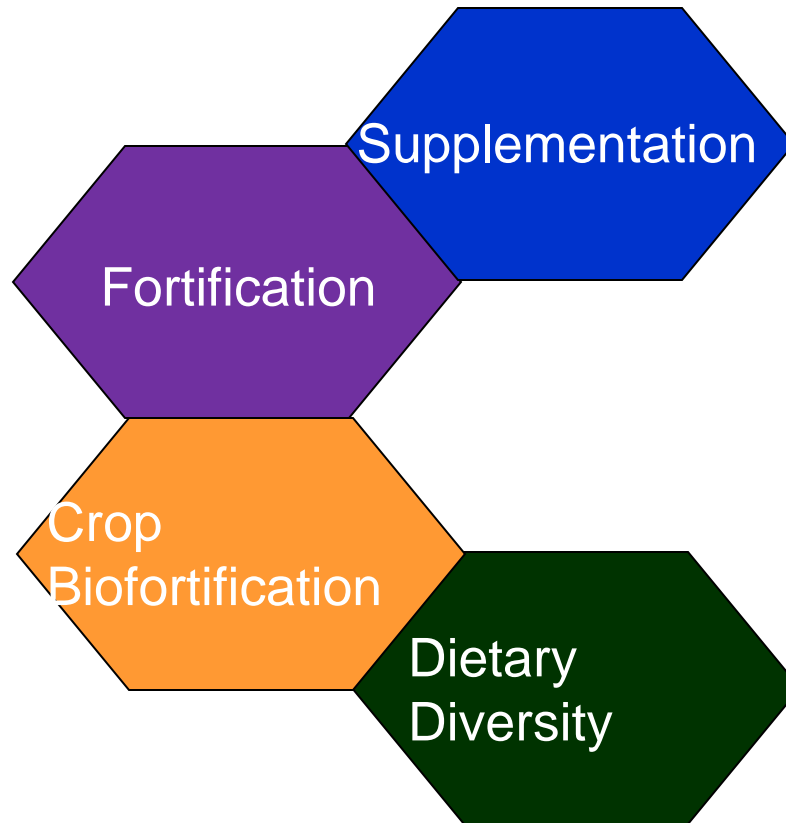
Micronutrients added to foods during industrial processing



Public Health Interventions

How they work

Nutritious
options
available for
consumption

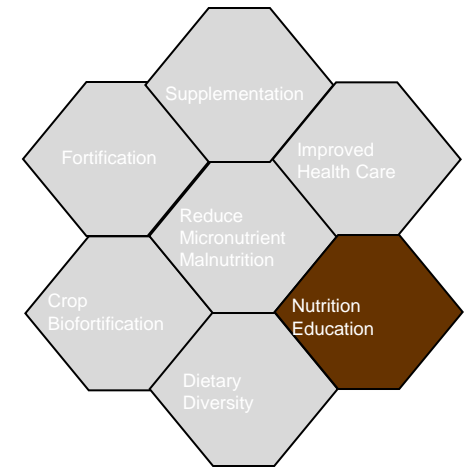


Public Health Interventions

How they work

Nutritious
options
available for
consumption

People choose to
consume more
nutritious options



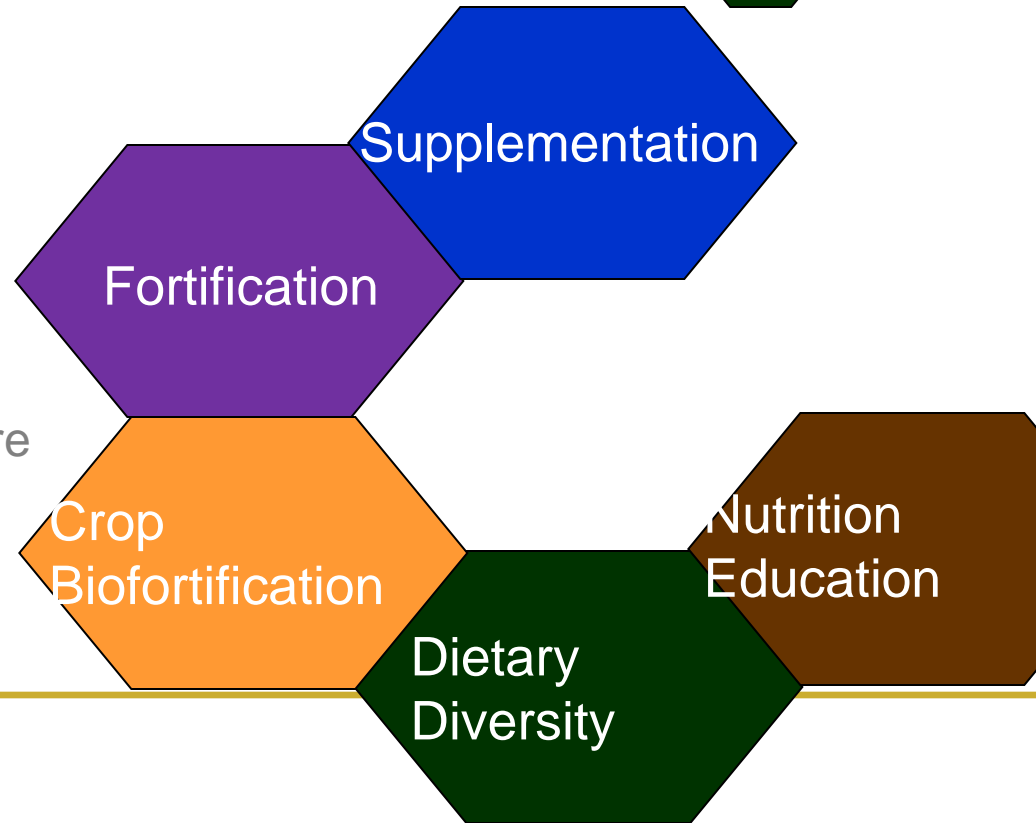
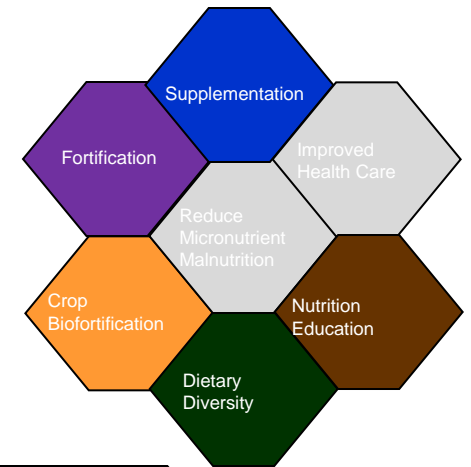
Public Health Interventions

How they work

Nutritious options available for consumption

People choose to consume more nutritious options

People eat more micronutrients



Public Health Interventions

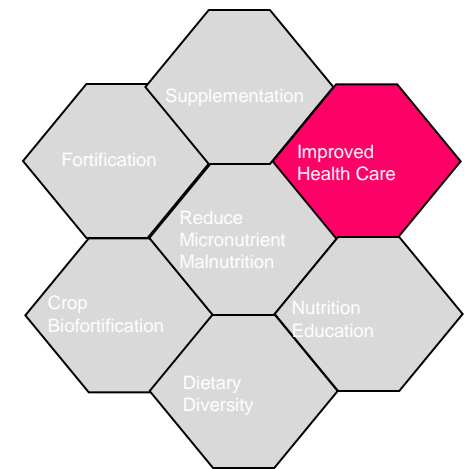
How they work

Nutritious
options
available for
consumption

People choose to
consume more
nutritious options

People eat more
micronutrients

Body can better
absorb and utilize
micronutrients



Public Health Interventions

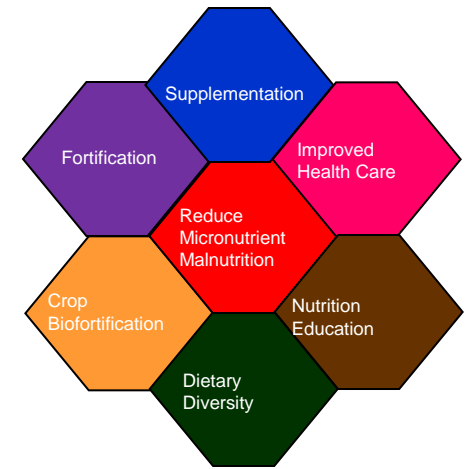
How they work

Nutritious options available for consumption

People choose to consume more nutritious options

People eat more nutrients

Body can better absorb and utilize micronutrients



**Reduce
Micronutrient
Malnutrition**



Conclusions

- Micronutrient malnutrition negatively affects the health, development and productivity of millions
- Successful interventions exist to reduce micronutrient malnutrition
- For countries to consider:
 - What are the key nutrient deficiencies faced?
 - What interventions, alone or in combination, can best address these problems?



For More Information

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LinkedIn.com



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